PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 7/22

A2

(11) International Publication Number: **WO 98/19482**

(43) International Publication Date: 7 May 1998 (07.05.98)

(21) International Application Number: PCT/US97/19760

(22) International Filing Date: 31 October 1997 (31.10.97)

(30) Priority Data:
08/741,460 31 October 1996 (31.10.96) US

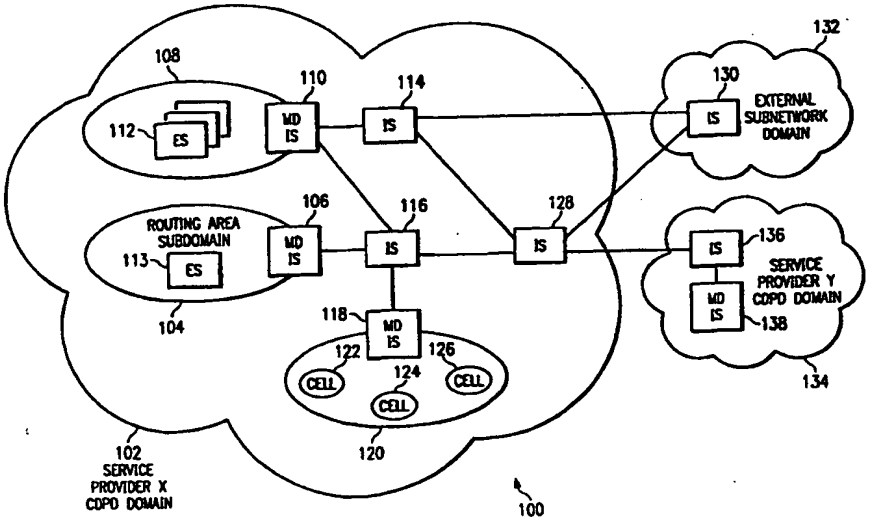
(71) Applicant *(for all designated States except US)*: NORTHERN TELECOM INCORPORATED [US/US]; 2221 Lakeside Boulevard, P.O. Box 833858, Richardson, TX 75083-3858 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: QADDOURA, Emad, A. [US/US]; 1320 Watersedge Drive, Plano, TX 75093 (US). AKHTAR, Haseeb [US/US]; 3102 Pamela Place, Garland, TX 75044 (US).

(81) Designated States: BR, CA, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: SYSTEM AND METHOD FOR ROUTING IN A CELLULAR DIGITAL PACKET DATA NETWORK



(57) Abstract

Routing of data in a mobile radiotelephone system to an intended recipient roaming mobile end station (M-ES) is facilitated by determining if the M-ES is within the same geographic area of the originating data source. If the M-ES is within the same geographic area as verified by interrogation of the local mobile data interface station, then data is sent directly to the intended M-ES without transmission to the mobile end station's home mobile data interface station. If the intended recipient M-ES is not currently located within the same geographic area served by the orginating data source, then the data is transmitted to the M-ES's home mobile data intermediate station where the last known location of the roaming M-ES is stored and then onto the appropriate mobile data intermediate station for transmission to the intended M-ES.

BNSDOCID: <WO 9819482A2 I >

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

BNSDOCID: <WO___9819482A2_I_>

SYSTEM AND METHOD FOR ROUTING IN A CELLULAR DIGITAL PACKET DATA NETWORK

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to apparatus and method for communications and more specifically to mobile radio data communications systems.

DESCRIPTION OF THE RELATED ART

Circuit switching is inefficient for bursty mobile data services such as facsimile (fax), electronic mail (e-mail), and short messaging. First generation cellular systems that provide data communications using circuit switching have difficulty passing modem signals through the audio filters of receivers designed for analog air-interfaces. Inevitably, voice filtering must be deactivated when data is transmitted over first generation cellular networks, and a dedicated data link must be established over the common air-interface. The demand for packet data services has, until recently, been significantly less than the demand for voice services, and first generation subscriber equipment design has focused almost solely on voice-only cellular communications. The cellular digital

BNSDOCID: <WO 9819482A2 I >

packet data (CDPD) standard was developed to coexist with the conventional voice-only cellular system.

However, numerous shortcomings exist with CDPD systems. One such shortcoming occurs when a mobile end-station (M-ES) is roaming away from the area covered by its home mobile data intermediate station (MD-IS). Much time, overhead processing and routing resources are expended in forwarding the data to the MD-IS serving the area in which the M-ES is now visiting.

There is accordingly a need for improvements in the system and method for routing digital packet data to a roaming M-ES in a Cellular Digital Packet Data network in order to solve or ameliorate the above-described problem.

SUMMARY OF THE INVENTION

Cellular Digital Packet Data (CDPD) is a data service for first and second generation U.S. cellular systems and uses a full 30 kHz AMPS channel on a shared basis. CDPD provides mobile packet data connectivity to existing data networks and other cellular systems without any additional bandwidth requirements. CDPD may directly overlay with existing cellular infrastructure and use existing base station equipment, making it simple and inexpensive to install, or it may be incorporated within new systems. Furthermore, CDPD does not have to use the Mobile Switching

BNSDOCID: <WO___9819482A2_I_>

Center (MSC), but rather may have its own traffic routing capabilities. CDPD occupies voice channels purely on a secondary, noninterfering basis, and packet channels are dynamically assigned (hopped) to different cellular voice channels as they become vacant, so the CDPD radio channel varies with time.

According to a specific implementation of our invention, routing of data to an intended recipient roaming mobile end station (M-ES) within a CDPD network is facilitated by determining if the roaming station is within the same geographic area of the originating data source. If the intended recipient roaming mobile end station is within the same geographic area as verified by interrogation of the local mobile data interface station, then data is sent directly to the intended mobile end station without transmission to the intended mobile end station's home mobile data interface station.

If the intended recipient mobile end station is not currently located within the same geographic area served by the originating data source, then the data is transmitted to the mobile end station's home Mobile data intermediate station where the last known location of the roaming mobile end station is stored and then on to the appropriate mobile

BNSDOCID: <WO 9819482A2 I >

data intermediate station corresponding to the last known location.

Advantages of the current invention include reduced processing time, less network overhead in transferring data messages throughout the network and a reduction in congestion due to no longer needing to encapsulate and decapsulate data into and from data packets for transmission.

The foregoing features together with certain other features described hereinafter enable the overall system to have properties differing not just by a matter of degree from any related art, but offering an order of magnitude more efficient use of processing time and resources.

Additional features and advantages of the invention will be set forth in part in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BNSDOCID: <WO__9819482A2_I_>

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate preferred embodiments of the apparatus and method according to the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a typical cellular network of the present invention.

Fig. 2 illustrates a simplified block diagram of a Mobile Data Intermediate Station (MD-IS).

Fig. 3 illustrates a message flow diagram for data transfer when the originator and intended recipient are served by the same Mobile Data Intermediate Station (MD-IS).

Fig. 4 illustrates a message flow diagram for data transfer when the originator and intended recipient are served by different Mobile Data Intermediate Stations (MD-ISs).

Fig. 5 illustrates a flow chart of the method of data transfer of the present invention.

DETAILED DESCRIPTION

Cellular Digital Packet Data (CDPD) is a data service for first and second generation U.S. cellular systems and uses a full 30 kHz AMPS channel on a shared basis. CDPD may also be utilized with digital systems such as IS-54 or

GSM TDMA as well as Code Division Multiple Access (CDMA) systems such as IS-95. CDPD provides mobile packet data connectivity to existing data networks and other cellular systems without any additional bandwidth requirements. It also capitalizes on the unused air time which occur between successive radio channel assignments by the Mobile Switching Center (MSC) (it is estimated that for 30% of the time, a particular cellular radio channel cellular radio channel is unused, so packet data may be transmitted until that channel is selected by the MSC to provide a voice circuit).

CDPD may directly overlay with existing cellular infrastructure and use existing base station equipment, making it simple and inexpensive to install, or it may be incorporated within new systems. Furthermore, CDPD does not have to use the MSC, but rather may have its own traffic routing capabilities. CDPD occupies voice channels purely on a secondary, noninterfering basis, and packet channels are dynamically assigned (hopped) to different cellular voice channels as they become vacant, so the CDPD radio channel varies with time.

A mobile end system (M-ES) is a mobile station that originates and/or receives data such as fax, e-mail or short messaging. It has an associated home Mobile Data

Intermediate System (MD-IS). Data intended for the recipient M-ES heretofor has always been routed to the home MD-IS.

Referring now to Fig. 1, a cellular digital packet data network (CDPD) 100 is presented. One of the unique attributes of CDPD network 100 is that M-ESs 112 change their subnetwork point of attachment with an MD-IS 106,110,114,138 at will therefore making traditional forms of network connectivity and routing ineffective. The route to a recipient M-ES 112,113 may often not be determined by examination from a network address due to its roaming capability.

The geographic area over which CDPD Network service is available is subdivided into cells 122-126, areas 104,108,120 and domains 102,132,134.

A cell 122-126 (not all cells are shown) is defined by the geographic area covered by a single Mobile Data Base Station (MDBS) (not shown), or in the case of sectorized cells, the sector. In any given cell 122-126 or sector, there may be zero, one or more than one physical channels available for CDPD service.

An MDBS is under the control of a single Mobile Data Intermediate Station (MD-IS) 106,110,114,138. The combined geographic coverage of all MDBSs under the control of a single MD-IS defines a routing area sub-domain 104.

BNSDOCID: <WO 9819482A2 | >

A CDPD domain 102,132,134 is defined by the set of MD-ISs operated and administered by a single CDPD Provider. Mobility between those separate Service Providers is governed by contractual agreements but technically is no different between areas served by a single Service Provider.

Each M-ES 112,113 is aware of the cell 122-126 in which it is located based on the channel stream it is currently using. When M-ES 112,113 moves to another cell, it notifies the network 100 by indicating a change to the channel stream used in the new cell. M-ES 112,113 registers its Network Entity Identifiers (NEI) with the CDPD Network through the Mobile Network Registration Protocol (MNRP). When registered with the CDPD Network, M-ES 112,113 is a transitory member of a current serving area subdomain; that is, it has a serving MD-IS.

Each M-ES 112,113 is identified by one or more unique Network Entity Identifiers (NEIs), which are used to route messages to the M-ES. Each NEI has a single home subdomain; that is, the NEI home MD-IS. The NEIs for a given M-ES may refer to different home subdomains. When operating in its home area, the serving and home subdomains for an M-ES are the same; they are different when the MES is outside its home area.

BNSDOCID: <WO___9819482A2_I_>

Mobile Data-Intermediate Stations (MD-ISs) 106,110,118,134 perform routing functions based on additional knowledge of the current location of M-ESs. MD-ISs are the only network-relay systems that have any knowledge of mobility and operate a CDPD-specific Mobile Network Location Protocol (MNLP) to exchange location information.

Referring now to Fig. 2, each MD-IS 110 performs two distinct mobility routing functions that cooperate to provide location-independent network service.

The first mobility routing function is the Mobile Home Function (MHF) 256. Every M-ES is logically a member of a fixed home area. The home area provides the anchor or mobility-independent routing destination area for fixed permanent Intermediate Stations (ISs) 114,116,128,130,136.

The Mobile Home Function (MHF) 256 consists of two services, a Location Directory Service (LDS) 258 and a Redirection and Forwarding Service (RFS) 260.

Location Directory (LD) 260 maintains an information base of the current serving area for each of its home M-ESs while Redirection and Forwarding Service (RFS) 258 provides MHF 256 packet forwarding service in the forward direction only. The redirection and forwarding function is based on the principle of encapsulating M-ES addressed

BNSDOCID: <WO 9819482A2 I >

packets and forwarding them to MSF 254 in the serving area in which the M-ES is currently visiting.

In the forward direction (packets destined for an M-ES), packets are routed by traditional means first to the MD-IS (for example 110) in the home area 108, then encapsulated and tunnelled to the MD-IS (in this example 106) in the current serving area 104, then routed to M-ES 113 at its current cell location.

Packets originating from an M-ES are routed directly to their destination by traditional means. There is no requirement for packets in the reverse direction to transit the home MD-IS.

The Mobile Serving Function (MSF) 254 of an MD-IS 110 handles the routing of packets for all visiting M-ESs in its serving area. When an M-ES registers for network access in an MD-IS 110 serving area, MSF 254 notifies the home MD-IS of its current location.

The MSF consists of two services, Registration Directory Service (RDS) 262 and Readdress Service (RS) 264.

Registration Directory Service (RDS) 262 maintains an information base of the M-ESs currently registered in the serving area.

BNSDOCID: <WO__9819482A2_I_>

Readdress Service (RS) 264 decapsulates forwarded Network Protocol Data Units (NPDUs) from another MD-IS and routes them to the correct channel stream in a cell.

Also, the serving MD-IS management functions cooperate with the network support service applications for authentication, authorization and accounting of the use of the network services by the M-ES.

The situation where the originator of data and the intended recipient are within same MD-IS will be discussed by referring to Fig. 3. When a data message is originated by an originator 302 it is sent via link 306 to the local MD-IS 304 responsible for that area. If the intended M-ES 310 happens to be roaming within the geographic area served by local MD-IS 304, then the roaming status location is recorded in RDS (see item 262 in Fig. 2) of MSF 254. The data message is then routed directly to intended M-ES 310 via link 308 without further routing through the network to the M-ES's home MD-IS.

The situation where the originator and intended recipient are not located within the area served by the same MD-IS requiring Redirection and Forwarding will now be discussed with reference to Fig. 4.

When an M-ES 402 has visited out of its home area and has registered for service in its current area, NPDUs

BNSDOCID: <WO 9819482A2 | >

transmitted via link 416 intended for M-ES 402 may follow different routes through the network than NPDUs originated by the M-ES 402.

The Redirection Service provides a mechanism for forwarding NPDUs that are originated from outside the M-ES's current serving area. The Redirection Service at the home area MD-IS 406 participates in the standard Network Layer routing protocols, such that it advertises direct Network Layer reachability to NSAP addresses corresponding to its home area M-ESs. NPDUs addressed to an M-ES will, therefore, be routed and relayed by traditional means to the Redirection Service associated with the destination.

When the Redirection Service receives an NPDU addressed to one of its home area M-ESs, it queries the Location Directory (LDS 258 of Fig. 2) within MD-IS 406 to obtain a mapping between the home area Network Service Access Point (NSAP) address and the current Forwarding Address.

The Redirection Service encapsulates the original NPDU in a new NPDU addressed to the Forwarding Address. The encapsulated NPDU is then routed by traditional means 412 to the Readdress Service at the serving area MD-IS 404 where M-ES 402 is currently located.

When the Readdress Service at the serving area receives an NPDU addressed to its Forwarding Address, it

BNSDOCID: <WO___9819482A2_I_>

decapsulates NPDU, restoring the original NPDU addressed to the destination M-ES. The original NPDU is then routed by traditional routing to the current cell of the M-ES.

If an originator happens to be an M-ES, the NPDU is routed by traditional means to its destination. There is no need to redirect NPDUs to the originator's home area. If the destination happens to be another M-ES, it will be routed to that M-ES's home area and handled as above.

Fig. 5 is a representation of the method of operation of the instant invention in flowchart form. Flow begins at Start 510. Data is sent from a data originator to the network intended for an M-ES capable of roaming among geographic areas served by at least one MD-IS in step 520. In step 530 the MSF at the serving MD-IS is interrogated to see if the intended M-ES is within the area served by that MD-IS. The addresses of the various M-ESs are compared in step 540. If a match occurs in step 540, then the intended M-ES is known to be located within the area served by the current MD-IS and control is transferred to step 550. Step 550 operates to send the data message to the intended M-ES and flow stops at step 560.

If the address of the intended M-ES is not found in step 540, then it is known that the intended M-ES is not located within the geographic area served by the MD-IS in

BNSDOCID: <WO 9819482A2 I >

which the data originated. In that event, control is transferred to step 570 where the data message is sent to the home MD-IS of the intended recipient M-ES. The Mobile Home function (MHF) of the home MD-IS is then interrogated to ascertain the current (or last known) whereabouts of the intended recipient M-ES. The data is then sent to the intended recipient M-ES through the MD-IS in which the intended recipient M-ES is currently located. That current location may be either its home location or its roaming location.

Data may be sent from an M-ES, a fixed station or the network, any of which may be an originator or source of data.

The above described invention is applicable to various transmission modes, including a simplex mode one way broadcast message to at least a single M-ES, a half-duplex mode broadcast message with message reception acknowledgement and to a full-duplex two way fully interactive communication.

Other such embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is readily apparent that the above described invention may be implemented in any type of radiotelephone system including a cellular or microcellular, public or

BNSDOCID: <WO___9819482A2_I_>

private system that involves any method that uses differentiation of modulation types of a RF channel to identify a control channel. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

WHAT IS CLAIMED IS:

1. In a mobile radiotelephone network including a cellular digital packet data capability with a plurality of mobile data intermediate stations including a local mobile data intermediate station and a home mobile data intermediate station, the home mobile intermediate data station corresponding to a mobile end station capable of roaming, a method of communicating with a mobile end station including the steps of:

transmitting data between an originator and the local mobile intermediate station;

transmitting data between the local mobile intermediate station and a roaming mobile end station when the roaming mobile end station is located within an area served by the local intermediate station, without transmitting data to the home mobile data intermediate station.

2. The method of claim 1 further comprising the step of searching a local database to determine whether a recipient roaming mobile end station is within an area served by the local mobile intermediate station.

3. The method of claim 2 further including the step of encapsulating data into packets prior to a transmission.

BNSDOCID: <WO___9819482A2_I_>

4. The method of claim 2 further including the step of transmitting data to the home mobile data intermediate station if the mobile end station is not roaming within the area of the local intermediate mobile station.

5. The method of claim 4 further including the step of determining the mobile data intermediate station which is serving the area in which the roaming mobile end station was last located.

6. The method of claim 5 further including the step of transmitting data to a third mobile data intermediate station which is serving the area in which the roaming mobile end station was last located.

7. The method of claim 6 further including the step of

a) transmitting data to the roaming mobile end station from the third mobile data intermediate station.

8. The method of claim 7 wherein step a) includes a simplex broadcast transmission to the mobile end station.

9. The method of claim 7 wherein step a) includes a half duplex broadcast transmission to the mobile end station.

10. A method of claim 7 wherein step a) includes a full duplex broadcast transmission to the mobile end station.

11. A mobile radiotelephone network for transmitting cellular digital packet data to a plurality of mobile data intermediate stations comprising:

a local mobile data intermediate station and a home mobile data intermediate station, the home mobile intermediate data station corresponding to a mobile end station capable of roaming;

a first transceiver for transmitting data between tan originator and the local mobile intermediate station;

a second transceiver for transmitting data between the local mobile intermediate station and a roaming mobile end station when the roaming mobile end station is located within an area served by the local intermediate station, without transmitting data to the home mobile data intermediate station.

12. The mobile radiotelephone network of claim 11 further including a local database for determining whether a recipient roaming mobile end station is within an area served by the local mobile intermediate station.

13. The mobile radiotelephone network of claim 12 further including means for encapsulating data into packets prior to transmission.

14. The mobile radiotelephone network of claim 12 further including means for transmitting data to the home mobile data intermediate station if the mobile end station is not roaming within the area of the local intermediate mobile station.

BNSDOCID: <WO___9819482A2_I_>

15. The mobile radiotelephone network of claim 14 further including means for determining the mobile data intermediate station which is serving the area in which the roaming mobile end station was last located.

16. The mobile radiotelephone network of claim 15 further including means for transmitting data to a third mobile data intermediate station which is serving the area in which the roaming mobile end station was last located.

17. The mobile radiotelephone network of claim 16 further including means for transmitting data to the roaming mobile end station from the third mobile data intermediate station.

18. The mobile radiotelephone network of claim 16 further including means for transmitting data in simplex mode to the roaming mobile end station from the third mobile data intermediate station.

19. The mobile radiotelephone network of claim 16 further including means for transmitting data in half-duplex mode to the roaming mobile end station from the third mobile data intermediate station.

20. The mobile radiotelephone network of claim 16 further including means for transmitting data in full-duplex mode to the roaming mobile end station from the third mobile data intermediate

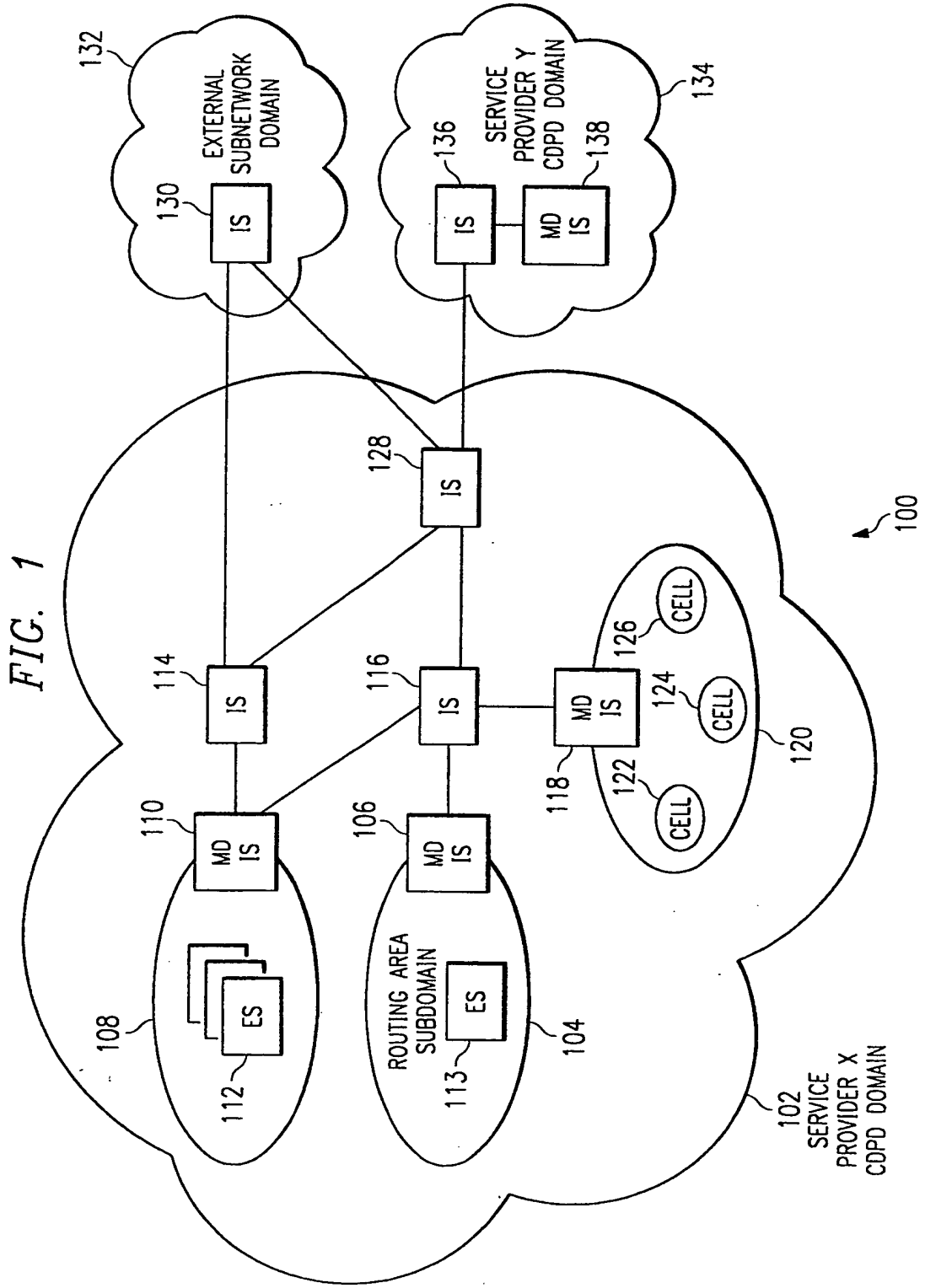


FIG. 1

BNSDOCID: <WO___9819482A2_I_>

FIG. 2

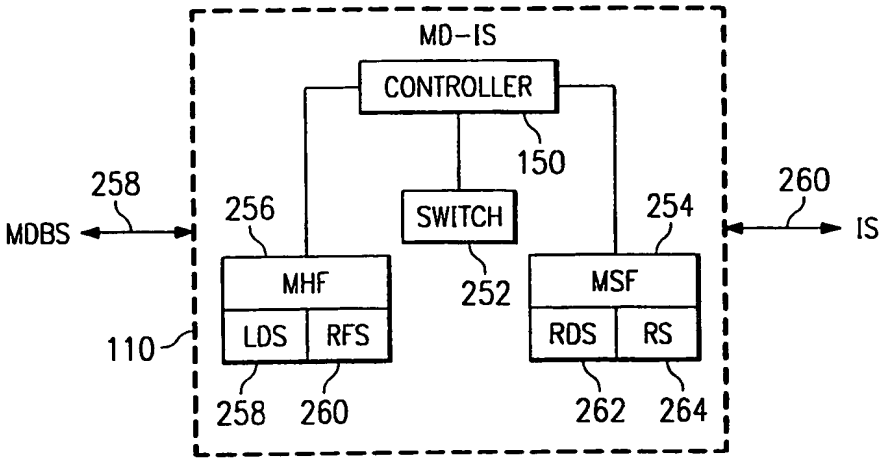


FIG. 3

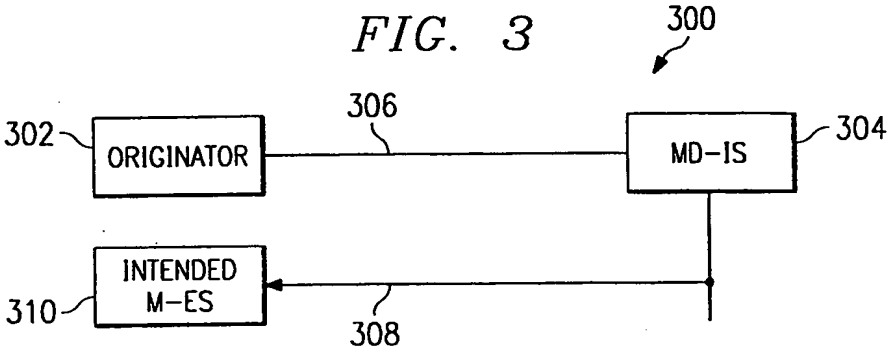
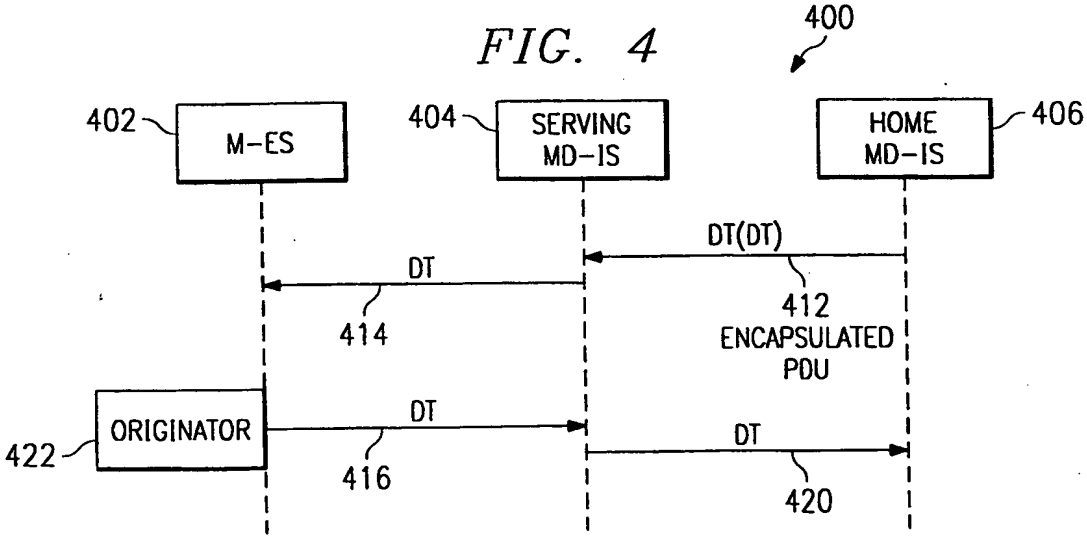


FIG. 4



RNSDOCID: <WO 9819482A2 I >

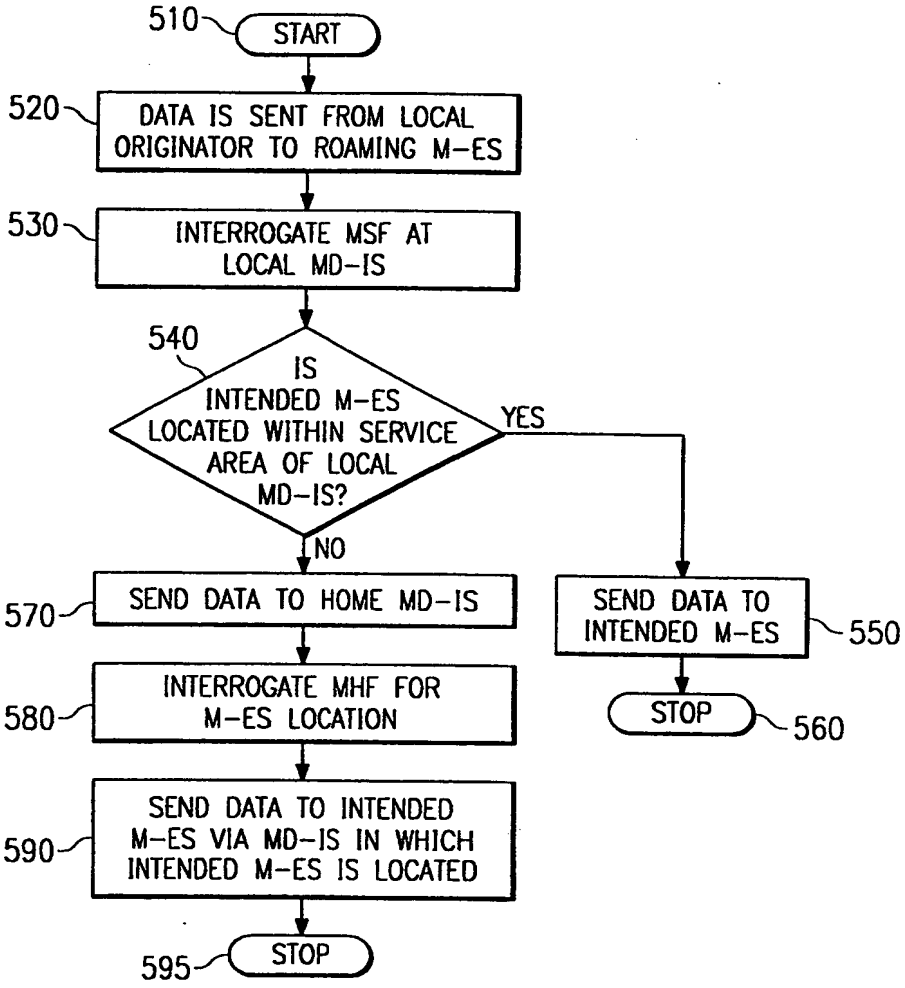


FIG. 5

BNSDOCID: <WO___9819482A2_I_>

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H04Q 7/22, 7/38

A3

(11) International Publication Number: **WO 98/19482**

(43) International Publication Date: 7 May 1998 (07.05.98)

(21) International Application Number: PCT/US97/19760

(22) International Filing Date: 31 October 1997 (31.10.97)

(30) Priority Data:
08/741,460 31 October 1996 (31.10.96) US

(71) Applicant *(for all designated States except US)*: NORTHERN TELECOM INCORPORATED [US/US]; 2221 Lakeside Boulevard, P.O. Box 833858, Richardson, TX 75083–3858 (US).

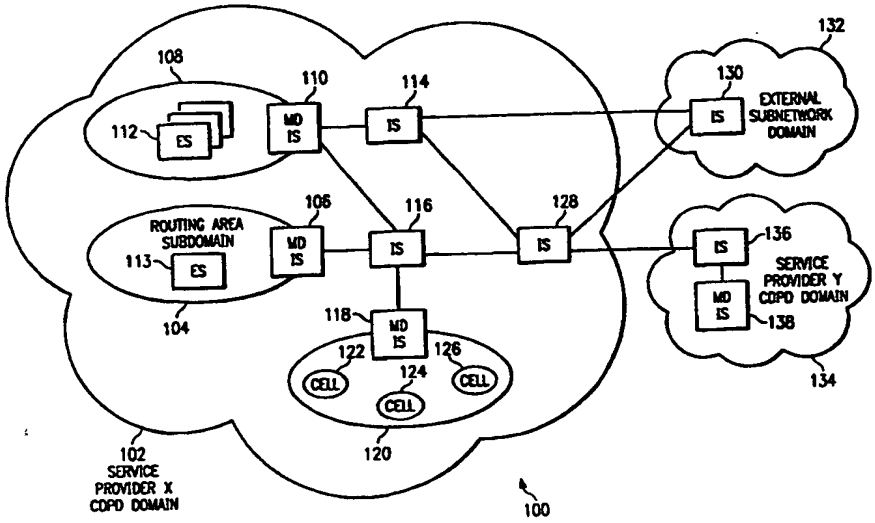
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: QADDOURA, Emad, A. [US/US]; 1320 Watersedge Drive, Plano, TX 75093 (US). AKHTAR, Haseeb [US/US]; 3102 Pamela Place, Garland, TX 75044 (US).

(81) Designated States: BR, CA, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report:
1 October 1998 (01.10.98)

(54) Title: SYSTEM AND METHOD FOR ROUTING IN A CELLULAR DIGITAL PACKET DATA NETWORK



(57) Abstract

Routing of data in a mobile radiotelephone system to an intended recipient roaming mobile end station (M–ES) is facilitated by determining if the M–ES is within the same geographic area of the originating data source. If the M–ES is within the same geographic area as verified by interrogation of the local mobile data interface station, then data is sent directly to the intended M–ES without transmission to the mobile end station's home mobile data interface station. If the intended recipient M–ES is not currently located within the same geographic area served by the orginating data source, then the data is transmitted to the M–ES's home mobile data intermediate station where the last known location of the roaming M–ES is stored and then onto the appropriate mobile data intermediate station for transmission to the intended M–ES.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

BNSDOCID: <WO___9819482A3_I_>

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 97/19760

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/22 H04Q7/38

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q

Documentation searched other than minimumdocumentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 16330 A (ERICSSON TELEFON AB L M) 15 June 1995 see page 30, line 10 - page 34, line 32 see page 36, line 16 - page 43, line 2 ---	1-20
X	MYLES A ET AL: "A MOBILE HOST PROTOCOL SUPPORTING ROUTE OPTIMIZATION AND AUTHENTICATION" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, vol. 13, no. 5, 1 June 1995, pages 839-849, XP000499090 see page 840, left-hand column, line 16 - page 841, right-hand column, line 21 see page 844, left-hand column, line 34 - page 845, left-hand column, line 44 --- -/--	1-20

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publicationdate of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of theinternational search	Date of mailing of the international search report
28 July 1998	04/08/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Roberti, V

1

Form PCT/ISA/210 (second sheet) (July 1992)

RNSDOCID: <WO 9819482A3 I >

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 97/19760

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PARSA K: "THE MOBITEX* PACKET-SWITCHED RADIO DATA SYSTEM" IEEE INTERNATIONAL SYMPOSIUM ON PERSONAL, INDOOR AND MOBILE RADIO COMMUNICATIONS, 19 October 1992, pages 534-538, XP000612275 see page 537, right-hand column, line 17 - page 538, left-hand column, line 39 ---	1-20
A	EP 0 399 612 A (PHILIPS ELECTRONICS UK LTD ;PHILIPS NV (NL)) 28 November 1990 see column 6, line 9 - column 7, line 14 ---	1-20
A	HAEMAELAEINEN J ET AL: "PROPOSED OPERATION OF GSM PACKET RADIO NETWORKS" IEEE INTERNATIONAL SYMPOSIUM ON PERSONAL, INDOOR AND MOBILE RADIO COMMUNICATIONS, vol. 1, 27 September 1995, pages 372-377, XP000645965 see the whole document -----	1-20

1

INTERNATIONAL SEARCH REPORT

information on patent family members

Inte onal Application No
PCT/US 97/19760

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9516330 A	15-06-1995	AU	675898 B	20-02-1997
		AU	1251595 A	27-06-1995
		CA	2153871 A	15-06-1995
		CN	1117335 A	21-02-1996
		EP	0683963 A	29-11-1995
		FI	953775 A	09-08-1995
		JP	8506713 T	16-07-1996
		SG	43755 A	14-11-1997
		US	5590133 A	31-12-1996
EP 0399612 A	28-11-1990	GB	2232562 A	12-12-1990
		AU	641103 B	09-09-1993
		AU	5594990 A	29-11-1990
		JP	3022639 A	31-01-1991
		US	5117423 A	26-05-1992

RNSDOCID: <WO 9819482A3 I >

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00041

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5412660 A (D.T. CHEN ET AL), 2 May 1995 (02.05.95), column 7, lines 47-51; fig. 4 -- US 5548586 A (EIJI KITO ET AL), 20 August 1996 (20.08.96), column 6, lines 23-54; column 7, line 38 - column 18, line 47; figures 5-6 -- --------	6,8 1-26

BNSDOCID: <WO___9832304A3_I_>

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/06/98

International application No.
PCT/FI 98/00041

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4989204 A	29/01/91	AU 2985589 A	10/08/89
		CA 1301845 A	26/05/92
		DE 68923102 D,T	02/11/95
		EP 0328100 A,B	16/08/89
		JP 2094176 C	02/10/96
		JP 2198229 A	06/08/90
		JP 8017346 B	21/02/96
		JP 1204545 A	17/08/89
		JP 1966987 C	18/09/95
		JP 6103883 B	14/12/94
		JP 1204546 A	17/08/89
		JP 1204543 A	17/08/89
		JP 2015261 C	02/02/96
		JP 7048712 B	24/05/95
US 5729537 A	17/03/98	AU 3199697 A	07/01/98
		WO 9748208 A	18/12/97
WO 9516330 A1	15/06/95	AU 675898 B	20/02/97
		AU 1251595 A	27/06/95
		CA 2153871 A	15/06/95
		CN 1117335 A	21/02/96
		EP 0683963 A	29/11/95
		FI 953775 A	09/08/95
		JP 8506713 T	16/07/96
		SE 9304119 D	00/00/00
		SG 43755 A	14/11/97
		US 5590133 A	31/12/96
WO 9633586 A1	24/10/96	AU 5411196 A	07/11/96
		EP 0821860 A	04/02/98
		NO 974762 A	11/12/97
WO 9700568 A1	03/01/97	EP 0832527 A	01/04/98
		PL 324002 A	27/04/98
US 5530963 A	25/06/96	BR 9405115 A	08/08/95
		CA 2130409 A	17/06/95
		CN 1111425 A	08/11/95
		EP 0663746 A	19/07/95
		JP 2577538 B	05/02/97
		JP 7202928 A	04/08/95
US 5412660 A	02/05/95	NONE	
US 5548586 A	20/08/96	GB 2292290 A,B	14/02/96
		GB 9516639 D	00/00/00
		JP 8056378 A	27/02/96

BNSDOCID: <WO___9832304A3_I_>